Agenda

12:00 – 1:00 PM	*Registration, Poster Setup, and Networking*
1:00 – 1:05 PM	Welcome, Admin Announcements and Agenda Overview John Paschkewitz, DSO Program Manager
1:05 – 1:10 PM	Contract Management Office (CMO) Overview Michael Mutty, Contracting Officer
1:10 – 1:25 PM	Defense Sciences Office (DSO) Overview Bill Regli, DSO Deputy Director
1:25 – 2:25 PM	CASCADE Overview John Paschkewitz, DSO Program Manager
2:25 – 2:45 PM	Government-Only Meeting (Review and answer question cards)
2:45 – 3:00 PM	Question and Answer Session (Live and Webcasted)
3:00 – 5:00 PM	Poster Session, Networking, and Sidebars

DARPA BAA PROCESS

Michael Mutty
DARPA Contract Management Office

December 9, 2015

- READ THE BAA

  - DRAFTING THE BAA
    - Words are Meaningful
    - Must and Shall
    - May
  - Technical vs Administrative
    - Technical Leads to “Selectable”
    - Administrative Leads to Contract Award
      - Cost Proposal
      - IP Assertions

BAA PROCESS

- PROPOSAL PREPARATION/SUBMISSION
  - Instructions are detailed in the BAA (**Follow closely**)
  - **ALL** questions to program mailbox: **CASCADE@darpa.mil**
  - FAQ (including today's) will be available on the program website on the DSO Homepage (**Read Regularly**)
  - Funding instrument types may vary from program to program but may include procurement contract(s), other transactions, assistance instruments (cooperative agreements)
- Assert rights to **all** technical data & computer software generated, developed, and/or delivered to which the Government will receive less than Unlimited Rights
- If you don't justify your proposed costs, we can't justify awarding you a contract.
  - Pay close attention to cost proposal instructions

BAA PROCESS

- EVALUATION/AWARD
  - Read Evaluation Criteria Carefully
  - Government reserves the right to select for award all, some (partial selection), or none of the proposals received.
  - Government anticipates making multiple awards
  - No common Statement of Work - Proposals evaluated on individual merit and relevance as it relates to the stated research goals/objectives rather than against each other
  - Overview of the Process
    - 3 Government Reviewers
    - PM Recommendation to the SRO
    - Notification

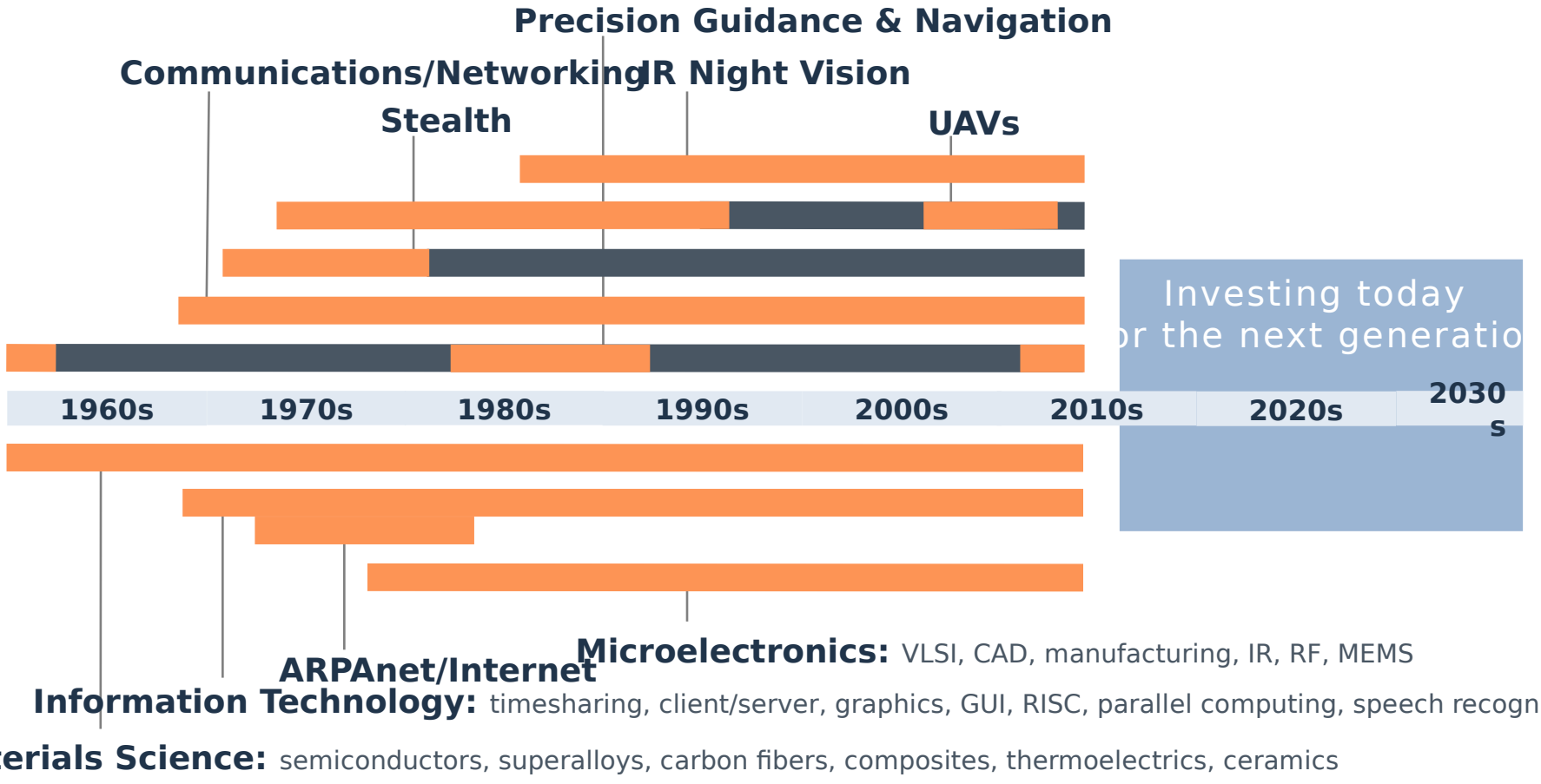
www.darpa.mil

Defense Sciences Office

Dr. Bill Regli

December 9, 2015

DARPA's Mission: Breakthrough Technologies For National Security



These new capabilities require a healthy ecosystem across Service S&T, universities, and industry

DARPA's role: pivotal early investments that change what's possible

DARPA Technical Offices

BTO — BIOLOGICAL TECHNOLOGY OFFICE

- Biological Complexity at Scale
- Neurotechnologies
- Engineering Biology
- Restore, Maintain and Improve Warfighter Abilities

DSO — DEFENSE SCIENCE OFFICE

- Math, Modeling & Design
- Physical Systems
- Human-Machine Systems

I2O — INFORMATION INNOVATION OFFICE

- Empower the Human within the Information Ecosystem
- Guarantee Trustworthy Computing and Information

MTO — MICROSYSTEMS TECHNOLOGY OFFICE

- Electromagnetic Spectrum
- Tactical Information Extraction
- Globalization

STO — STRATEGIC TECHNOLOGY OFFICE

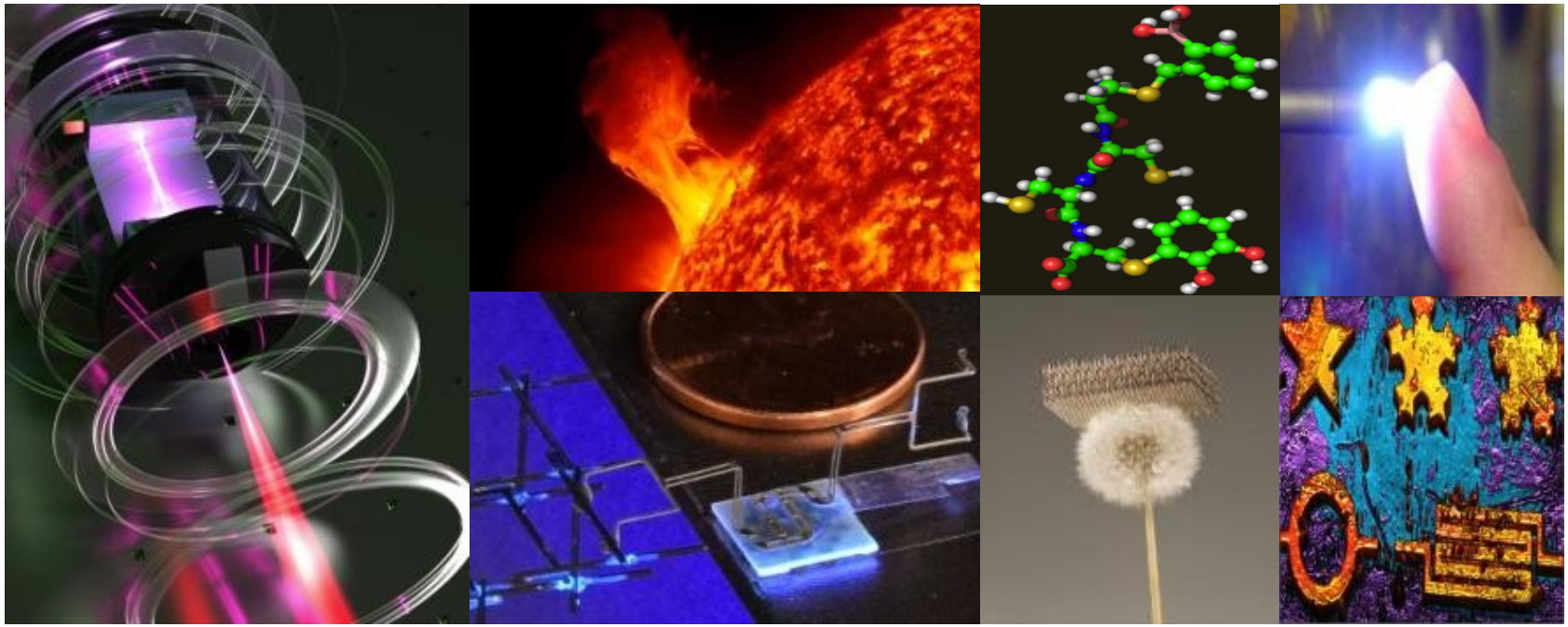
- System of Systems (SoS)
- Battle Management/Command and Control (BMC2)
- Communications and Networks (C&N)
- Electronic Warfare (EW)
- Intelligence Surveillance, and Reconnaissance (ISR)
- Positioning, Navigation, and Timing (PNT)

TTO — TACTICAL TECHNOLOGY OFFICE

System Focus Areas:
- Ground
- Maritime
- Air
- Space

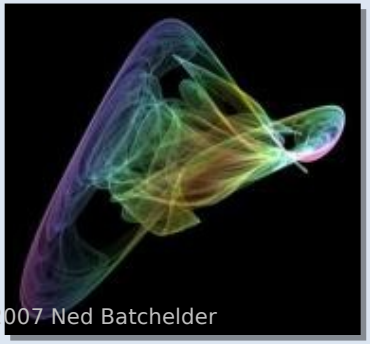
Crosscutting Themes:
- Agile development
- Cooperative Autonomy
- Unmanned Systems
- Power and Propulsion

DSO is “DARPA’s DARPA”



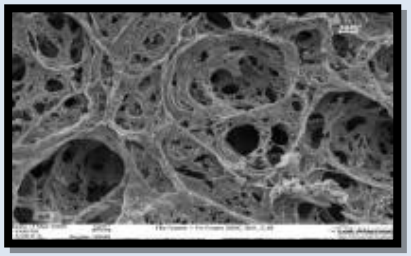
Accelerating breakthrough discoveries to create new enabling technologies for national security

Focus Areas



Math, Modelin g& Design

Physical Systems



Human-Machine Systems

Social Systems

We look forward to your ideas

Complex Adaptive System Composition And Design Environment (CASCADE)

Dr. John Paschkewitz
DSO

December 9, 2015

How can we design complex systems to meet unanticipated needs? Using arbitrary components?

Events: blizzard, earthquake, tsunami with nuclear event...

- **Structure**: buildings, HVAC, power grid, water network, roads, vehicles, ...
- **Behaviors**: electrical transmission, working sanitation, transportation...

Function

healthcare, housing, public safety, sustenance, ...

Constraints: road capacity, power grid capacity and storage, ...

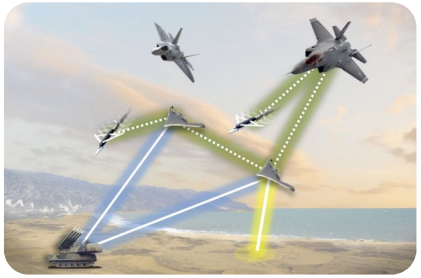
Resilient urban infrastructure

Christchurch, New Zealand, 2011 (Commons.Wikimedia.org)

Need: Fundamentally change how we design systems for real-time resilient response to dynamic, unexpected environments

Complex military systems can be similarly composed – and have similar challenges

Air Dominance SoS



- **Functions:** strike, ISR, EW, …
- **Structures:** manned and unmanned assets, communication networks, subsystems, materials, ….
- **Behaviors:** communications, PNT, jamming, transportation, …
- **Constraints:** power, logistics tail, …
- **Events:** environmental challenges, attrition, surprise red team capability, …

Forward surgical capability

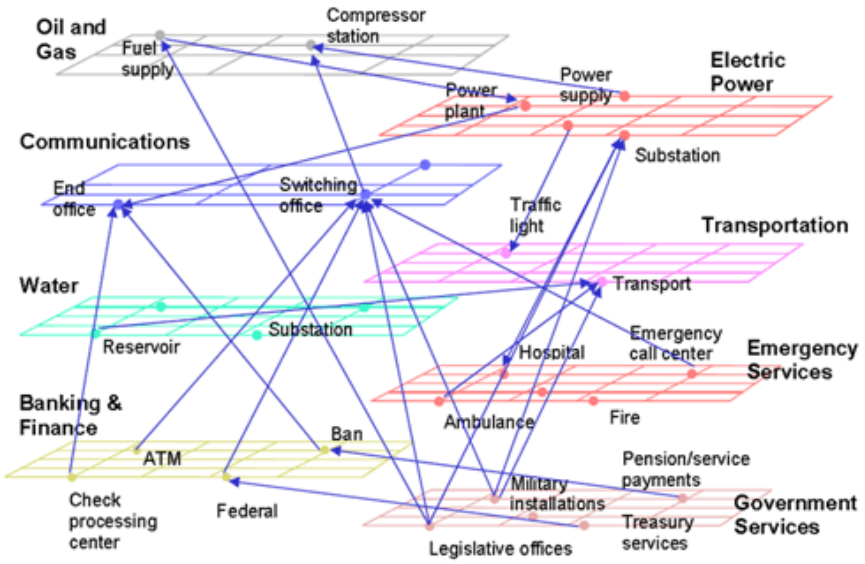
https://commons.wikimedia.org/

- **Functions:** resuscitative surgery, medevac
- **Structures:** surgeons, helicopters, communication networks,…
- **Behaviors:** medical skills, transportation
- **Constraints:** time, blood supply, mobility, surgeon risk, patient state…
- **Events:** environmental challenges, communications jamming, …

Complexity results from interactions between structures and behaviors across multiple time and spatial scales

Why can't we design resource-efficient resilient and adaptive complex systems today?

Design cycle



https://transition.fcc.gov/pshs/techtopics/techtopics19.html

Limitations & Challenges:

- ***Composition*** of structures, behaviors and constraints across scales *and* time
- ***Adaptation*** to dynamic environments with evolving threats in real

Goal: Demonstrate a validated capability to model and design complex adaptive systems starting from new mathematical foundations for composition and adaptation

Program elements

Challenge

Integrate formal mathematics for unified design

TA1: *Foundations*

Integrated teams address abstraction, composition and adaptation

Metrics

- *Computational complexity*
- *Formal verifiability*
- *Approximation methods*
- *Compositional generality*
- *Resilience and Adaptive limits*

Challenge

Build new design framework from mathematics up

TA2: *Applications*

Develop a new design capability for military SoS or urban resilience with **TA1** teams

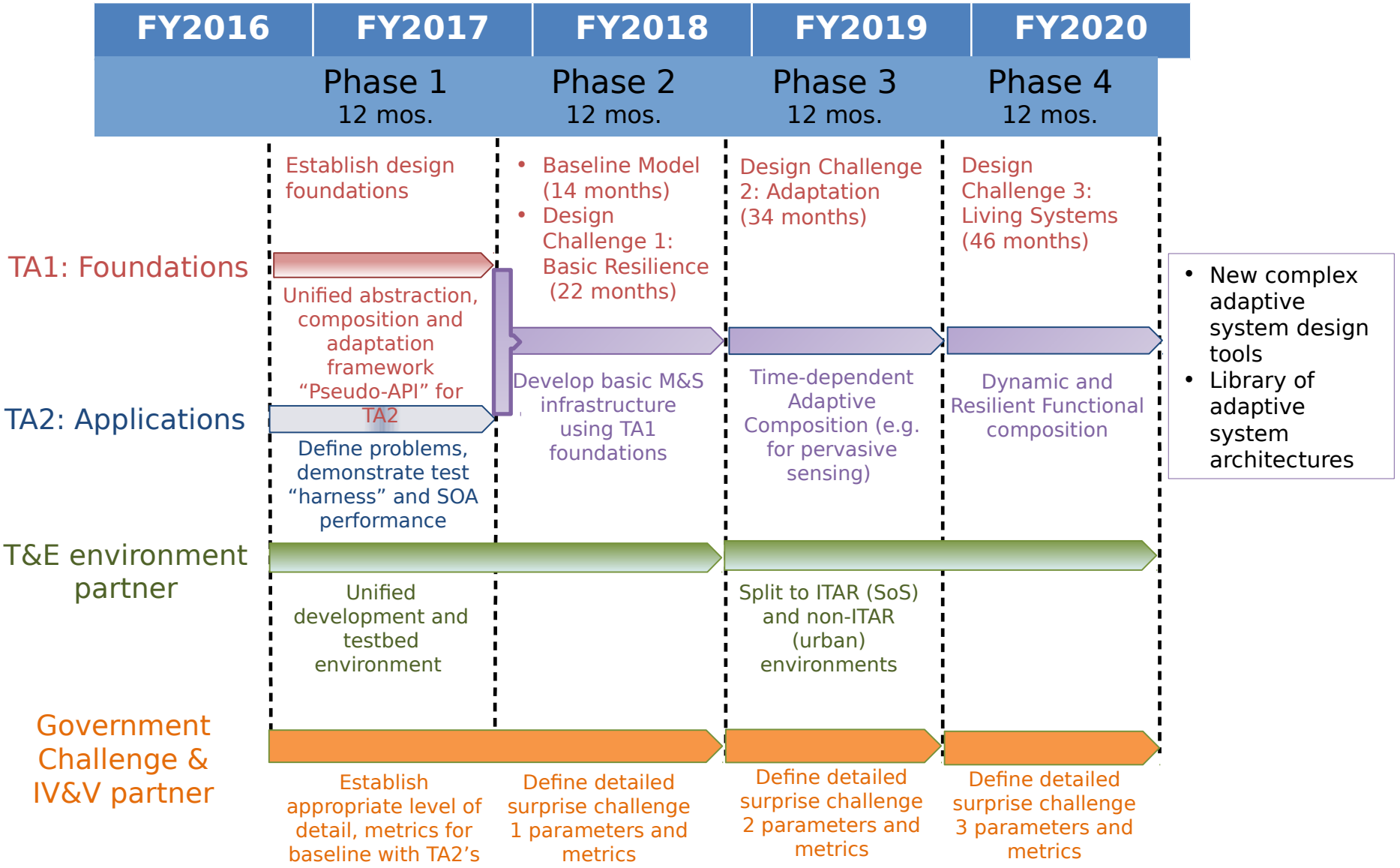
Metric

Prediction and design against real-world proble

- **Government Challenge Partner**
  Surprise problems and metrics
- **T&E partner**
  Single, collaborative test environment

End product: Complex adaptive system design tools with a library of resilient and adaptive designs

Program Schedule



TA1: Mathematical Foundations

GOAL: provide a *unified* formal mathematical foundation for complex adaptive system design incorporating abstraction, composition and adaptation

mages: top: http://en.wikipedia.org/wiki/Image:MorphismComposition-01.png, middle: c/o Rob Ghrist, UPenn, bottom:https://en.wikipedia.org/wiki/Chameleon

TA2: Applications

GOAL: Integrate deep knowledge of application area challenges and the new mathematical foundations of TA1 in powerful domain-specific modeling and design frameworks

Choose 1 of 2 application areas (see the BAA for more details):

- **Military systems of systems (SoS) *at the unclassified level*** – e.g., adaptive battlefield medicine, logistics, maintenance
- **Resilient urban infrastructure –** e.g.**,** Dynamic community function (e.g. health care, public safety) requiring composition of power, water, logistics, architecture, etc.

TA2 Proposers must define:

- System complexity – why can't this be adequately modeled now?
- Strategy for design framework – how will TA1 breakthroughs help and how will they be implemented?
- System metrics – what are figures of merit for both design tools & systems being designed?
- Transition strategy to application community – require open access to design capability and data

Must have integrated TA2 prime with TA1 subcontractor teams for phases 2-4

Example Challenge Problems: Urban Resilience

ntitative metrics to be established for specific proposer focus by government challenge pa

Phase 2: Resilience

- Predict community function in response to adverse event that does not permanently affect structure
- Example: Blizzard
- Identify most effective strategy for restoring community function to baseline state (determined at start of phase 2) and demonstrate a novel capability to design a more resilient architecture

Phase 3: Adaptation

- Predict community function in response event that *permanently destroys structures and changes behaviors & radically changes constraints*
- Example: Tornado, earthquake
- Identify most effective strategy for restoring community function to baseline state *and* alternative designs that are more resilient

Phase 4: Living Systems

- Predict community function in response to adverse event with *co-evolving threat* with *unknown set of time-variable structures, behaviors and constraints*
- Example: Disease outbreak after natural disaster
- Identify most effective strategy for restoring community function to baseline state *and* alternative designs that are more resilient

All images: wikipedia.org